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**The need for sustainable management of  
coral reef fish spawning aggregations**

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## The need for sustainable management of coral reef fish spawning aggregations

1. Many commercially important species of reef fishes exhibit the habit of ‘aggregation-spawning’ whereby all mating takes place in large temporary gatherings of conspecifics. Sometimes fish also migrate in large numbers to spawning sites. These mating-related gatherings and movements are often highly predictable in time and location and hence, once discovered, are often the basis of important seasonal fisheries. Yet, as we have come to discover over the last two decades, such reproductive gatherings are highly vulnerable to over-fishing and, if severely compromised by fishing, may cease to form completely. If this happens adults will no longer produce the eggs and larvae that form the basis of fisheries at non-reproductive times of the year, and the fishery is likely to collapse. Collapse would represent the loss of significant fisheries with important and sometimes serious implications for the human communities that depend on such fishes. Moreover, aggregations can represent significant biomass and movements of animals, and are formed by many species, highlighting the ecosystem importance of these biological events.

2. Species that predictably aggregate to spawn, or gather in large spawning migrations, include a diverse range of fishes of much importance as food and commercial benefit in the Pacific. They also include many species that are very vulnerable to over-fishing because of other aspects of their biology. In some places of the Pacific a significant proportion of the total annual landings of reef fishes comprise species that aggregate to spawn. Examples include some rabbitfishes (Siganidae) and surgeonfishes (Acanthuridae), bonefishes (Albulidae) and mullets (Mugilidae), most larger snappers (Lutjanidae), jacks (Carangidae), groupers (Serranidae), some parrotfishes and wrasses (Scaridae and Labridae), and some emperors (Lethrinidae) and sweetlips (Plectorhynchidae).

3. Examples of important aggregating species in the Pacific include *Epinephelus polyphekadion*, *E. fuscoguttatus*, *Plectropomus areolatus*, *Lutjanus bohar*, several species of surgeonfishes and rabbitfishes as well as mullets and the bonefish. In addition to aggregating to spawn, some of the larger reef fishes have life history characteristics, such as longevity and slow sexual maturation, that make them naturally vulnerable to over-fishing, with several already considered to be threatened or near-threatened according to the International Union for Conservation of Nature (IUCN) Red List ([www.iucnredlist.org](http://www.iucnredlist.org)). Examples include *Bolbometopon muricatum*, *Cheilinus undulatus*, *E. fuscoguttatus* and *E. polyphekadion*. A large species of sweetlip has apparently disappeared from some locations because it was so easy to catch when aggregated.

4. When exploitation is at low, subsistence, levels, sufficient just for immediate local community food needs, aggregations and migrations persisted as an important food supply for many human generations. Such examples show that it was possible to take small numbers of fish from these gatherings and still enjoy the benefit of fishing the species at other (non-aggregation) times of the years and over the long term. However, it is now clearly and widely documented that if such spawning aggregations or migrations are fished at commercial levels, or without sufficient controls on effort, they will become over-fished, some to the extent that they will no longer form. With no aggregation, there will be no spawning for the species and its fishery could move towards collapse in the region.

5. Because the increased use of reef fishes in the Pacific for commercial purposes is relatively recent and because fishery development over the last few decades (through mechanization of boats, technical advancements in fishing gear, etc.) has greatly increased the ability to catch fish, and because of growing coastal human populations, the problem of overexploitation is a relatively new and rapidly growing challenge that needs to be faced. It is particularly severe in the case of threatened or aggregating species that will be the first to disappear. Since there is little collective experience or long tradition that fishing communities can draw on regarding the threat of over-fishing aggregations, it is important that all available information be made available (including both traditional knowledge and scientific understanding) to warn of the dangers of over-fishing aggregations, and as a basis for good fishery management planning. Indeed, one of the biggest challenges to encouraging the management of aggregations is that the large number of fish they can yield belie the fact that they need to be carefully managed; only bitter experience has shown that even 'healthy-seeming' aggregations will continue to form even as populations decline until the point of sudden population collapse (a condition known as 'hyperstability' in fisheries science).

6. The implications of losing aggregating species can be severe for entire communities, especially where dependence on marine resources represents an important source of food and income. In extreme cases, the deterioration of marine resources, heralded by the loss of key biological phenomena like spawning aggregations and threatened species, can ultimately lead to community breakdown and dissolution, with members migrating to urban centres to try to make a living. Management of reef fish resources should, therefore, be a priority matter for communities and governments that rely on or otherwise benefit from their long-term sustainability, and is a key part of local and national food security.

### **Recommendations:**

- Spawning aggregations should only be exploited at **small-scale subsistence levels** and should otherwise be completely protected from fishing and maintained as 'sources' of fish (through the eggs/larvae produced) to support a steady and constant supply of fish for non-aggregation times (i.e. the majority of) the year.
- If target fish are only caught at their spawning aggregations and are not available at other times of the year, then **any aggregation-fishery that involves commercial use should be managed by a quota**, or by other suitable fishery management tools. **Ecosystem management planning should factor in the preservation of spawning aggregations.**
- Even if aggregations are managed, **aggregating species may also need to be managed at other, non-aggregation, times of the year** since many of the larger aggregating species, such as some of the groupers, can be over-fished due to their natural longevity and slow sexual maturation.
- Management options for spawning aggregation sites or migration routes can involve placing them in **marine protected areas, or closing the fishery during the aggregation/migration season, or throughout the year**. A sales ban may assist in enforcing a seasonal control with requirements for landing fish whole, or with a skin patch to enable species identification.
- Aggregations, if fished at all, should only be fished with hook and line or other **selective fishing gear to minimize bycatch** and to avoid over-fishing; using SCUBA and spear-fishing

can rapidly over-fish an aggregation, with spearfishing at night particularly problematic because resting fish are so easy to catch.

- Following the implementation of management, it is essential that aggregations are **monitored either yearly or every few years, by scientifically robust sampling protocols**, to determine whether management measures are effective and to allow for adaptive management.
- Enforcement of management regulations is often a major challenge and needs careful planning. **The understanding and cooperation of affected communities is important for successful enforcement** with government or other support often needed. **Educational campaigns are important for generating understanding and support for management initiatives** and should contribute to compliance.
- Fishery development projects, especially if aggregating species or spawning aggregations are involved, or are likely to be subjected to greater fishing pressure (such as with ice plant installation, enhanced fishing capacity, or market access development), should take into account the capacity of the resource to withstand higher fishing pressure. Development should, therefore be coordinated and compatible with **sustainable management based on an assessment of the population condition (stock assessment)**.
- Research is needed to better understand the distribution and dynamics of spawning aggregations. This should include the description and study of currently fished aggregation sites that might require **interviews in fishing communities**. Studies on the timing and location of exploited aggregations would assist in **determining the best timeframe and spatial needs for management**. Some species migrate *en masse* to spawning sites (e.g. rabbitfish, mullet, some groupers, etc.) and their **migration pathways may need management**. However, studies that attempt to identify unfished sites should be strongly discouraged unless effective management is already in place; the best protected sites are those that are unknown. Many commercially significant aggregating species are virtually unknown in terms of their biology and ecology; such studies would greatly assist their management.
- Spawning aggregations should be considered to be **indicators of general reef fishery condition** because they can signal: pressures on fishery resources caused by human activities (fishing);(b) environmental state (aggregation condition relevant to some baseline), and c) societal response by the degree to which they are managed effectively. **It is found that heavily overfished fisheries have few to no aggregations and, conversely, that healthy aggregations persist in well-managed or underfished fishery conditions**.
- Follow the recommendations from international Statements of Concern by IUCN, ICRI and the Inter-Tropical Marine Ecosystem Management Symposium, and reflected in the 1995 FAO Code of Conduct for Responsible Fisheries to protect or sustainably manage spawning aggregations.

Reference materials can be found on: [www.scrfa.org](http://www.scrfa.org)